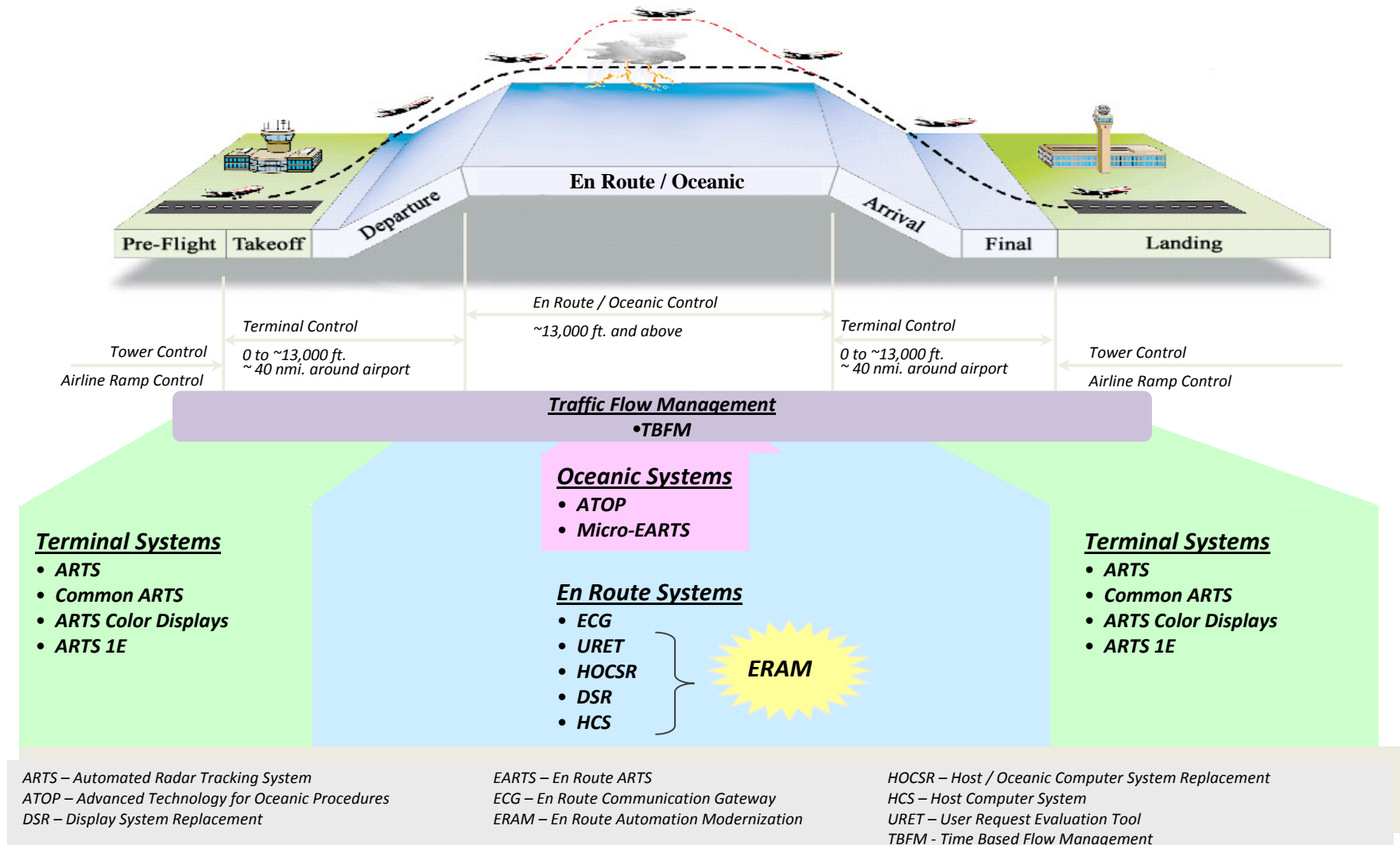


# Architecture of the FAA En Route Air Traffic Control System – ERAM

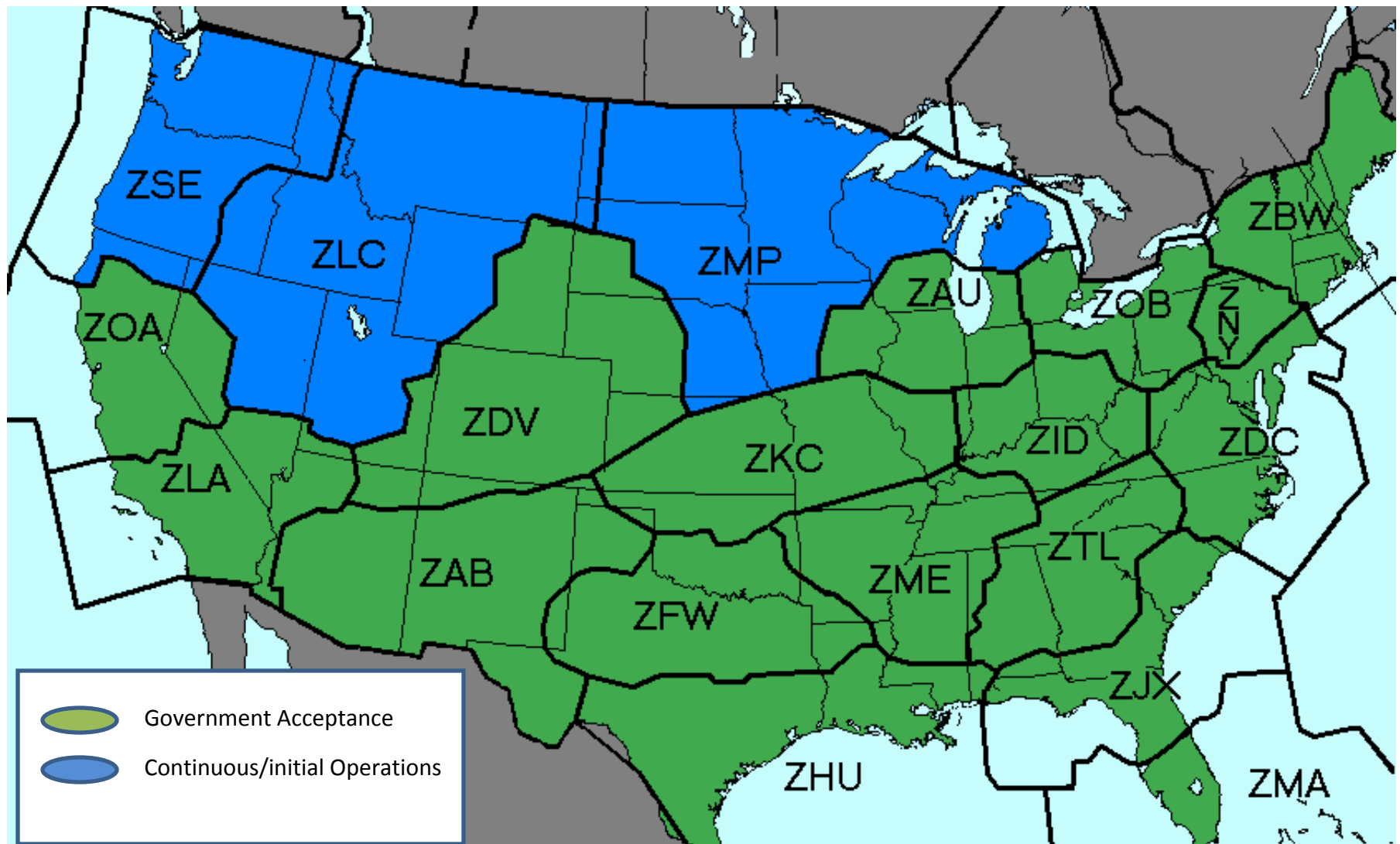
**Tony Ng, PhD**  
**ERAM Chief Architect**  
**Lockheed Martin IS&GS**



# Lockheed Martin Programs in the National Airspace System



# ERAM Site Operations

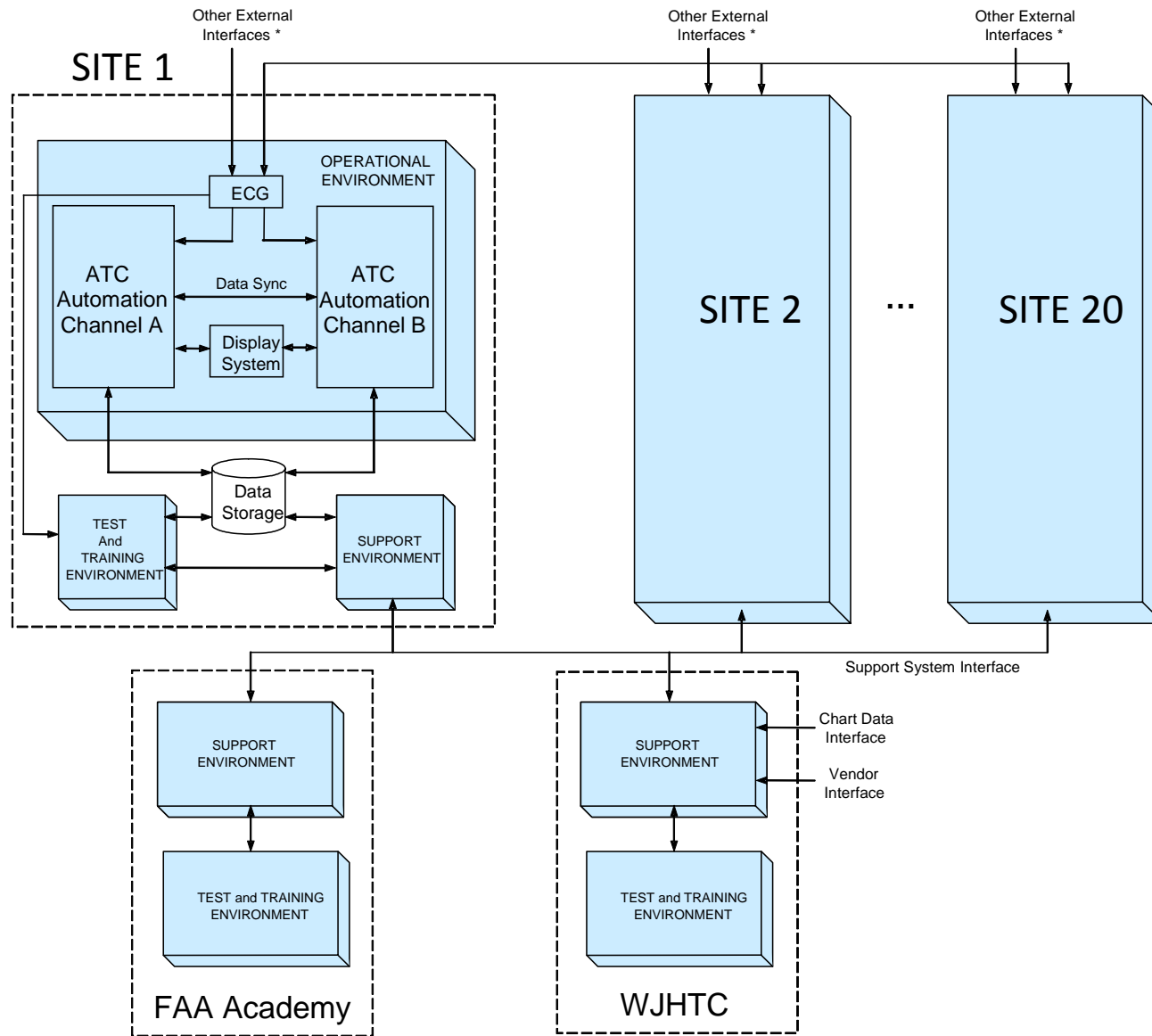


# ERAM Architecture Overview

- **ERAM replaces the primary and backup automation systems in the U.S. En Route Air Traffic Control facilities**
- **ERAM provides an open software architecture, with modular sub-systems, that is easily enhanced to support the evolving operational needs of the National Airspace System**
- **The ERAM architecture provides two highly available, full function channels**
  - Eliminates system down time due to scheduled and unscheduled outages
  - Allows more flexibility for scheduled maintenance
- **The ERAM architecture provides separation of mission critical and non-mission critical functions**
  - Reduces ATC critical service outages
- **The ERAM infrastructure provides increased security to protect the En Route information assets**

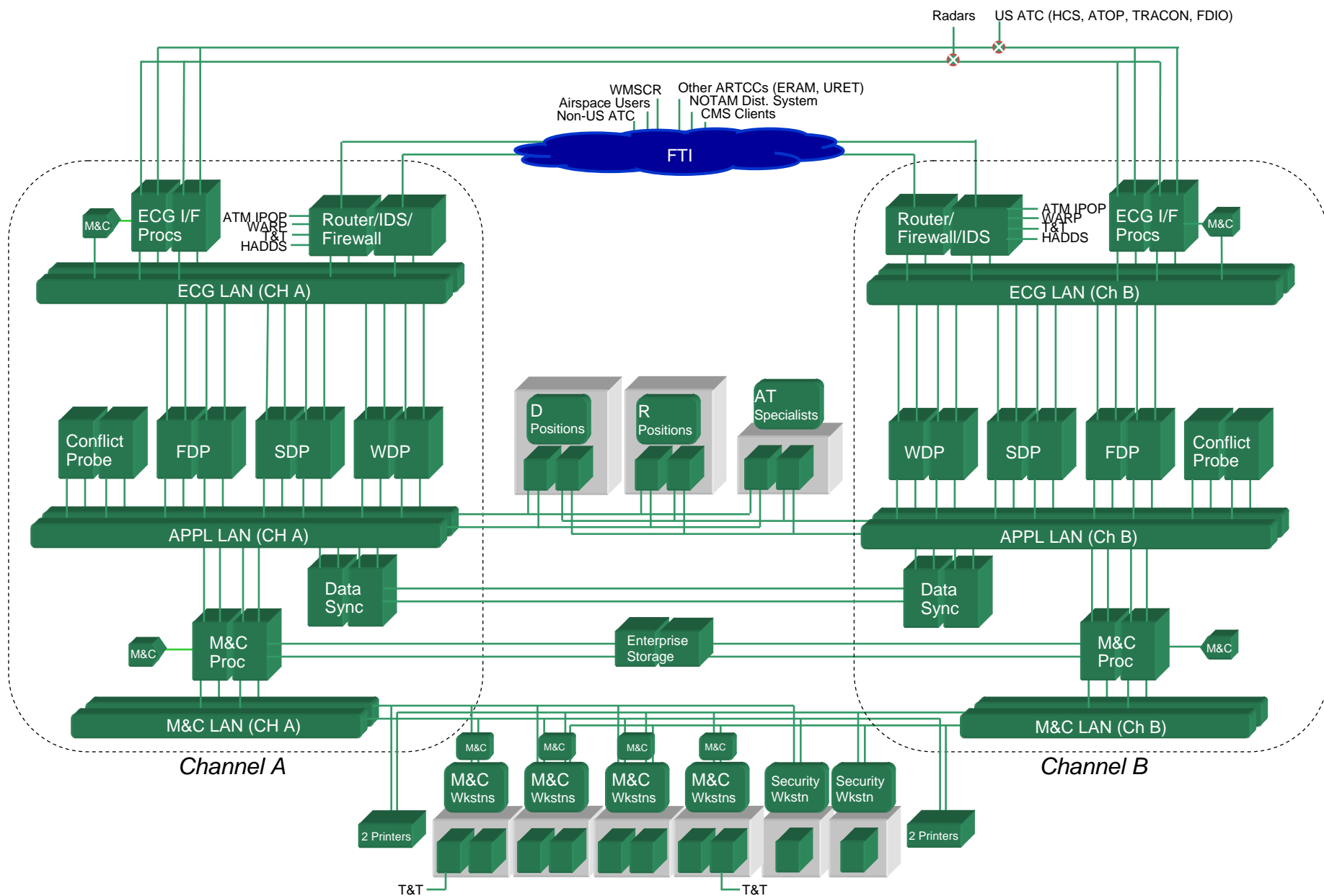


# ERAM in 22 Locations

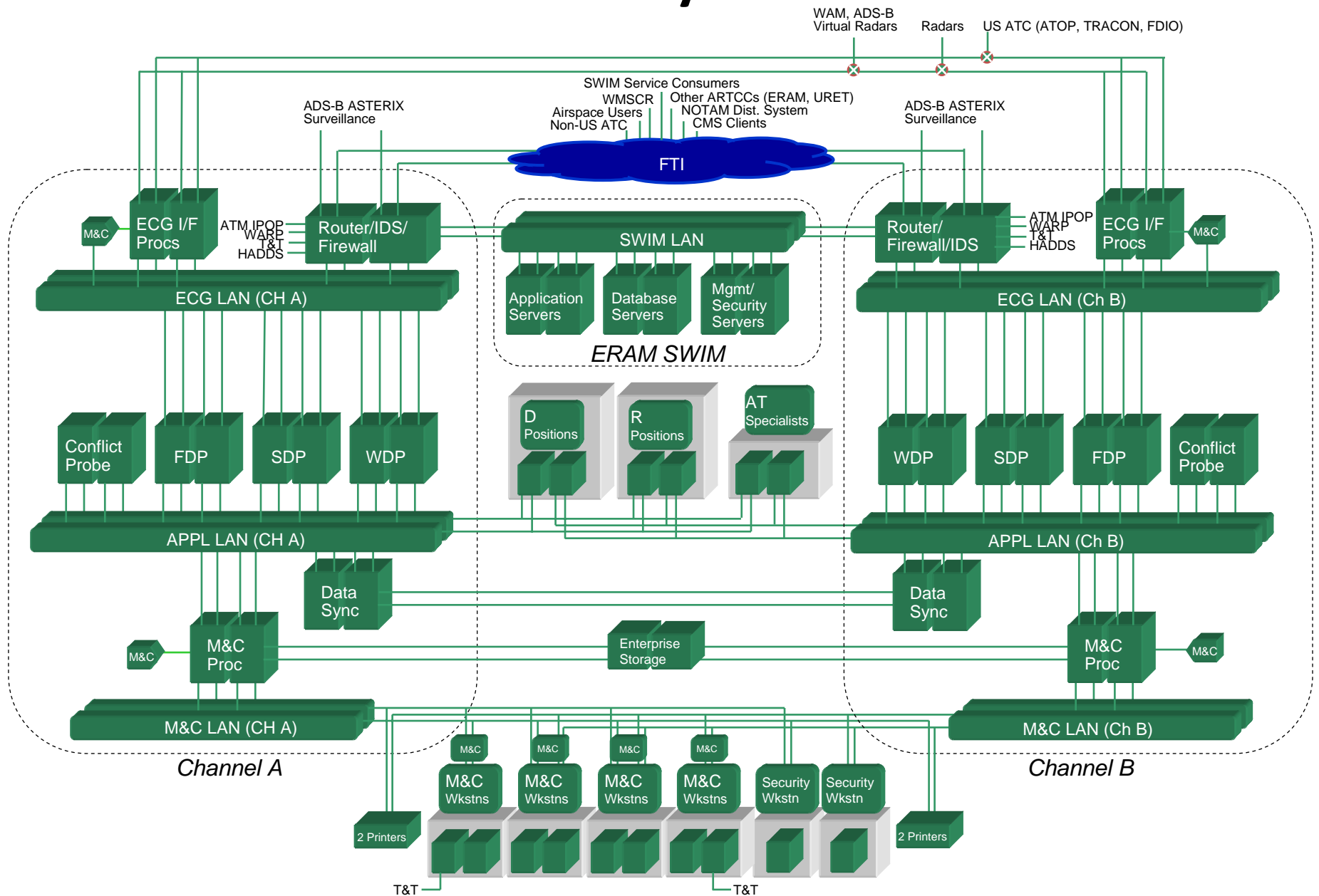




# ERAM Release 1 and 2 Physical Architecture



# ERAM Release 3 Physical Architecture



# ERAM Capabilities

- **ERAM Provides Enhanced Surveillance Data Processing**
  - Processes new types of surveillance data, including radars, Automatic Dependent Surveillance - Broadcast (ADS-B) and Wide Area Multilateration (WAM) data in CD-2 format
  - Multi-sensor tracking with Kalman filters
  - Advanced safety functions provide aircraft-to-aircraft and aircraft-to-terrain alerts
- **Flight Data Processing Enhancements Provide Capacity And Efficiency Improvements**
  - Provides full International Civil Aviation Organization (ICAO) flight plan processing, with net-centric flight object access
  - Provides flexible airspace management and route processing, improved interfacility coordination capabilities, and end-to-end route conversion for airspace users
  - Supports legacy and new external interfaces with interface proxy architecture
- **ERAM Provides Enhanced Weather Data Processing**
  - Processes weather grids containing wind, temperature, and pressure data for use by flight data processing trajectory modeling and for display at the controller positions
  - Formats Mosaiced Next Generation Weather Radar (NEXRAD) products for graphical display of precipitation data at the controller positions
  - Processes and distributes text-based meteorological information
- **Conflict Probe Capability Provides Strategic Planning**
  - Conflict Probe and Alert Notification
    - 20 minute look ahead for aircraft/aircraft and aircraft/airspace conflicts
  - Trial Planning – Model and Probe Potential Flight Plan Amendments



# ERAM Software Layers (Logical View)

CSCI

CSS

## *Simulation*

Simulation Engine  
(SIME)

## *Interfaces*

Monitor & Control (SMGT)

En Route Display  
Management (EDSM)

Interface Proxies Set A  
(IFPA)

Interface Proxies Set B  
(IFPB)

## *Derived Information*

Safety (SAFE) - SAF

Monitor Flights (MONF)

Flight Evaluation (EVAL)

## *Aircraft Specific*

Surveillance (SURV)

Flight Services (FLTS)

## *Facility Wide*

Safety (SAFE) - AAV

Weather Data Processing  
(EWDP)

Aeronautics (AERO)

General Information  
Processing (EGIP)

## *Services*

System Management  
(SMGT)

Recording (SARP)

Sunhillo ECG  
Product (SEP)

Air Traffic Management  
Services (ATMA)

Processor Services (PSVC)

Communication Services  
(COMM)

Display Services (DSRV)

# ERAM Software Architecture

- **Component Based Architecture**
  - Domain objects analysis led to definition of components
    - Framework developed for implementation
  - Implementation of any component can be changed without impact to users of components – as long as the interfaces (APIs) are invariant
  - Components are grouped together to provide Services to Applications
- **Key drivers in the architecture:**
  - Scalability, Availability, Performance
- **Major components (groupings of finer-grained components) form the basis of Service Oriented Architecture (SOA) Services to be provided**

# Accessibility of Component Data

- **Server/Publisher has master copy of data**
  - E.g., Flights, Precipitation
- **Clients/Subscribers make asynchronous requests**
  - E.g., Amend Flight, Subscribe to Precipitation
- **Ephemeral data is used upon receipt, no need to refer to it later (no need to read it, query it)**
  - Proxy Client/Subscriber used in such cases
  - No local store of a copy of the published data is retained by the component; data is passed through to client/subscriber via callbacks
- **Longer lived data is useful to have around for synchronous queries**
  - Mirror Client/Subscriber used in such cases
  - Local copy (read-only) of the published data is retained by the component; data is passed through to client/subscriber via callbacks and is also available for synchronous reads against all objects in the local mirror